

RemarksStatus of the Claims

Claims 1-31 are pending in the application. All claims stand rejected. By this paper, claims 1, 8, 18, 27, 29, and 30 have been amended. Reconsideration of all pending claims herein is respectfully requested.

Interview

The applicant wishes to thank the Examiner for the courtesy of the telephone interview on December 1, 2005. The applicant has made the changes that the Examiner suggested would overcome the art of record, but understands that the Examiner will perform a follow-up search.

Claim Rejections

Claims 1, 8, 12, and 29 were rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,269,078 to Lakshman et al. ("Lakshman"). Claims 2-7, 9-11, 13-17, and 27-28 were rejected under 35 U.S.C. 103(a) as being unpatentable over Lakshman in view of Ito et al. ("Ito"). Claims 18, 21-22, and 26 were rejected under 35 U.S.C. 103(a) as being unpatentable over Lakshman in view of Humpleman. Claims 19-20 and 23-25 were rejected under 35 U.S.C. 103(a) as being unpatentable over Lakshman et al. in view of Humpleman and further in view of Ito. These rejections are respectfully traversed.

The claimed invention allows a media server to more efficiently serve multimedia programs to multimedia nodes in a bandwidth-limited network. For

example, a wireless home network with a maximum bandwidth of 54 Mbps may be limited to only two or three multimedia nodes if the bandwidth is equally distributed between the nodes. However, in practice, multimedia programs do not always require the same amount of bandwidth at any given time. For example, in video, scenes with a high degree of movement require greater bandwidth than static scenes. This creates bitrate peaks or spikes, which are significantly higher than the average bitrate.

In accordance with the claimed invention, a media server is able to take into account the bandwidth requirements for each requested media program and adjust the relative amount of bandwidth allocated to the requesting nodes, allowing the media server to potentially accommodate additional nodes. For example, each node may be initially allocated an amount of bandwidth that is less than what is required to handle bitrate spikes for a requested media program. However, prior to spike occurring, the media server may temporarily increase the bandwidth allocation to a particular node, allowing it to buffer a sufficient amount of data to accommodate the spike.

However, this type of bandwidth reallocation requires the media server to know, at any given time, the bandwidth requirements for each media program being transmitted to a respective node. Indeed, the media server needs to anticipate a bitrate spike for a particular media program well in advance in order to compensate for it. The amount of lead time necessary to reallocate bandwidth and prefill buffers is directly related to how "tight" the bandwidth constraints are. For example, in order to maximize bandwidth usage among several multimedia nodes, the multimedia server

may need to know about upcoming bandwidth spikes that won't occur for several minutes in order to provide time to prefill the buffers at the receiving node.

Conventionally, advance knowledge about bandwidth spikes has been unavailable because media servers have not previously generated and stored bitrate histograms for entire media programs. As a result, media servers have been required to "estimate" or "predict" how much bandwidth is required, typically on the basis of the past requirements or forecasting models. This, however, often results in buffer underruns, which cause video and audio degradation, when predictions prove to be inaccurate.

1. Lakshman Merely "Predicts" But Does Not "Know" the Bandwidth Requirements for a Particular Media Program to be Transmitted

Lakshman could not be more different from the claimed invention. Rather than knowing the amount of bandwidth required at any given time for a particular media program based on a "previously-generated" bitrate histogram, as in the claimed invention, Lakshman is limited to "predicting" bandwidth requirements.

- Lakshman uses a "mechanism for *predicting* demands to be made of the network based on the *character* of the video information *which is to be encoded in the future*." Col. 5, lines 2-4 (emphasis added).
- "Having considered the active and inactive sources and their characteristics, it is thus possible [for Lakshman] to *model* and thus *predict* what cell rate needs will be for an encoder based on the types of video to be transmitted." Col. 10, lines 13-16 emphasis added, quoted by Examiner).
- "The *forecasting* can be done using the source model developed in the Heyman article." Col. 9, lines 60-61 (emphasis added).

- “[I]n video teleconferènces, I frames can be *modeled* by a Marcov chain with a DAR (1) transition matrix similar to that used for a video teleconference.” (emphasis added).
- “Having discussed the techniques for *predicting a demand* including the timing for such a prediction and the smoothing out of the request or demand based on predictions over a window of frames, It is appropriate to consider how the network treats the demand and how the *encoder adapts to the response from the network*.” Col. 11, lines 12-16 (emphasis added).

As described with respect to FIG. 5, Lakshman's encoder predicts (501) the need for rate allocation for future frames and provides (502) the predicated rate to a network. The network allocates (504) bandwidth in response to the request and advises (504) the source of an explicit rate based on the actual available bandwidth. The encoder at the source then adjusts (505) the current rate based on the advised explicit rate.

Lakshman's system is designed to work with video that has not yet been encoded, such as video conferences. See col. 5, lines 3-4 (“video information *which is to be encoded in the future*”); col. 4, lines 1-4 (“the present invention provides a new method and system for transporting compressed video that provides feedback control of the *encoding rate*”). Based on models of typical “types of video to be transmitted” (col. 10, line 16), Lakshman can only predict what the bandwidth demand for an actual media program might be. Indeed, the Examiner admits that “[i]nformation illustrated by the histogram of Figure 6A is used in the *forecasting models*.” Office Action at page 3 (emphasis added). Mathematical models, as of the type described in Lakshman (cols. 7-10), are not “bitrate histograms” for particular media programs, as claimed. They are based on “studied sequence[s]” of data, as shown in the “histogram” of FIG. 6A. See col. 9, lines 47-50.

By contrast, there is no need to "predict" bandwidth requirements in the claimed invention. The claimed invention does not "forecast" bitrate requirements, nor does it rely on "models." Because the claimed media programs are "previously-encoded," such as a DVD or other existing media program, the system is able to generate a bitrate histogram of the program by which its actual bitrate requirements at "any given time" may be known (not predicted). The claimed invention does not "adjust" the encoding rate, which is contrary to the whole point of Lakshman. See col. 4, lines 1-4 ("the present invention provides a new method and system for transporting compressed video that provides feedback control of the *encoding* rate").

In response to the foregoing argument in the applicant's prior response, the Examiner argued that the "features upon which applicant relies (i.e., claimed invention conclusively knowing the bitrate) are not recited in the rejected claim(s). Office Action at page 2. However, the applicant respectfully submits that a "previously-generated histogram of bitrate as a function of time," which exists prior to transmission of the media program, and which is identified prior to transmission for purposes of anticipating a future bitrate spike, is the very definition of "conclusively knowing the bitrate." A system that can identify a "histrogram of bitrate of a function of time for a media program" inherently "knows" the bitrate for the media program at any given time, as contrasted with Lakshman's mere prediction.

While the applicant believes that the original claim language clearly distinguishes over Lakshman, the applicant has amended the independent claims to recite: "each bitrate histogram indicating actual bitrate requirements for every given

point of time within the associated multimedia program," an "actual bitrate spike," "actual changes in bitrate requirements," and the like.

2. Lakshman Does Not Disclose a Histogram of Bitrate as a Function of Time Indicating Bitrate Requirements at Every Given Point of Time Within the Associated Multimedia Program

The applicant respectfully submits that Fig. 6A of Lakshman is not the claimed "histogram of bitrate as a function of time" as suggested in the Office Action. Rather, it is a histogram of the "frequency" with which a particular number of "cells per frame" occurs within a "studied sequence." The number of cells per frame does not determine the frame rate. Indeed, the frame rate is determined by specific standards for a particular medium, e.g., 30 frames per second for TV. Fig. 6A is completely lacking in a time axis, which could be used to identify when bitrate spikes occur within a particular media program.

The Examiner responded to the applicant's argument that there is no time axis by stating that the "cell rate per frame is a function of time because video inherently [is] related to time (frames per second)." Office Action at page 2. However, this completely ignores the claimed limitation of "function of time," and completely ignores the figure, which does not include a time dimension.

While video is sometimes expressed in "frames" per second, the histogram of FIG. 6A does not show this, yet the Examiner argues that Lakshman's histogram is identical to the claimed histogram under 102(e). An anticipation under section 102 is proper only if the reference shows exactly what is claimed. Titanium Metals Corp. v. Banner, 778 F.2d 775, 780 (Fed. Cir. 1985); MPEP § 2131. In this case, no one of

ordinary skill in the art would reasonably argue that FIG. 6A shows a histogram of bitrate "as a function of time."

Accordingly, Lakshman's histogram is completely unable to perform its claimed purpose, i.e., allowing a media server to anticipate the precise point in time at which a bitrate spike occurs. Knowing the temporal location of the bitrate spike, the server may compensate for it by changing bandwidth allocations.

With regard to FIG. 6A of Lakshman, of what possible use would it be to know there were a total of 1000 occurrences of frames that include 100 cells? This does not say when such an event occurred. It cannot be used to anticipate bitrate spikes. The applicant respectfully asks the Examiner how the "temporal characteristic" (location of a bitrate spike) can be identified from FIG. 6A, as suggested at page 4 of the Office Action.

Notwithstanding the foregoing, the applicants have amended claim 1 to recite that "each bitrate histogram [indicates] actual bitrate requirements at every given point of time within the associated multimedia program." Thus, the bitrate histogram serves as a temporal "map" of bitrate fluctuations, allowing the server to anticipate and compensate for bitrate spikes. Even if the prior language was debatable, the amended language is not. Lakshman does not disclose or suggest a histogram of bitrate as a function of time that indicates "bitrate requirements at every given point in time within the associated multimedia program."

The addition of Ito does not cure the deficiencies of Lakshman. Ito does not disclose bitrate histograms. Rather, Ito's video data index includes instructions for how to extract certain frames of video data to achieve one of several different bitrates

depending on the network load. In other words, if the network load won't permit the transmission of full 1.5 Mbps video data, Ito's server degrades the video quality, as instructed in the video data index, by selecting some frames and dropping others.

The addition of Humpleman does not cure the deficiencies of Ito and Lakshman. Humpleman merely discloses a home network system that provides browser-based command and control. Nothing in Humpleman suggests the claimed bitrate histogram. Furthermore, nothing in Humpleman suggests modifying a bandwidth allocation in anticipation of a bitrate spike indicated within a bitrate histogram.

Because the cited references fail to disclose the limitations of claim 1, they cannot anticipate claim 1. Anticipation under section 102 is proper only if the reference shows exactly what is claimed. Titanium Metals Corp. v. Banner, 778 F.2d 775, 780, 227 USPQ 773, 777 (Fed. Cir. 1985); MPEP § 2131.01. The applicant respectfully submits that claim 1 is patentably distinct over the cited references. Claims 2-7 depend directly or indirectly from claim 1 and are thus believed to be patentably distinct for at least the same reasons.

Claim 8 recites dynamically adjusting said first amount of bandwidth based on a previously-generated template of bitrate data as a function of time. As explained above, Lakshman does not disclose a template of bitrate as a function of time that indicates actual bitrate requirements for every given point in time within a multimedia program to be transmitted. Furthermore, Lakshman does not disclose a previously-generated histogram of bitrate as a function of time associated with a previously-

encoded multimedia program. Accordingly, claim 8 is also believed to be patentably distinct.

3. The References Do Not Disclose or Suggest Modifying the Bandwidth Allocation of a First Multimedia Node Based on the Bitrate Histogram of a Program Being Sent to a Second Multimedia Node

Claim 12 recites "dynamically adjusting said first amount of bandwidth based on a template of bitrate data as a function of time indicating changes in bitrate requirements of a multimedia program requested by a second multimedia node."

The applicant respectfully points out that the Office Action completely fails to address the claimed limitation. The rejection on page 6 misquotes the claim, dropping the phrase "requested by a second multimedia node."

The ability to alter the bandwidth allocation of a first multimedia node based on a bitrate histogram of a program being sent to a second multimedia node is not taught or even suggested by the references. Even if all of the Examiner's arguments are correct, the references would only teach altering the bandwidth allocation of a first multimedia node based on a bitrate histogram of program being sent to the first multimedia node. Lakshman looks at a program being sent to a multimedia node in isolation. There is no hint that Lakshman allows the bandwidth allocation for a multimedia node to be altered based on a bitrate histogram for a program other than the program being received by that node.

Likewise, claim 29 further recites "identifying a second stored bitrate histogram associated with a second multimedia program to be transmitted to a second multimedia node, the second bitrate histogram indicating a future spike in bandwidth

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requirements for the second multimedia program" and "throttling back the bandwidth allocated to the first multimedia program just prior to encountering the bandwidth spike associated with the second multimedia program at a time sufficient to fill a buffer of the first multimedia node." The applicant respectfully submits that none of the cited references disclose throttling back bandwidth of a first multimedia program based on an anticipated spike in the bandwidth requirements of a second multimedia program as indicated by a bitrate histogram for the second multimedia program.

4. The Office Action Does Not Address the Specific Limitations of Claim 30

As amended, claim 30 recites a method comprising:

generating a histogram of bitrate as a function of time for an entire media program before a transmission thereof to a multimedia node, the bitrate histogram indicating bitrate requirements at every given point of time within the associated media program;

allocating a first amount of network bandwidth for transmitting the media program to the multimedia node, the first amount being a subset of available network bandwidth to the multimedia node;

identifying, during transmission of the multimedia program, an actual upcoming bitrate spike within the bitrate histogram for the multimedia program, the actual bitrate spike temporarily requiring more than the available network bandwidth for transmission of the multimedia program; and

temporarily increasing the bandwidth allocation for the multimedia node from the first amount to a second amount in anticipation of the actual bitrate spike indicated in the bitrate histogram, the temporarily increased bandwidth allocation being sufficient to fill a buffer at the multimedia node to avoid a buffer underrun at the multimedia node during the actual bitrate spike.

Although listed among the 35 U.S.C. 103(a) rejections, the claim is discussed very briefly in connection with the 35 U.S.C. 102(e) rejections. Accordingly, the applicant respectfully requests clarification as to the correct basis for rejection.

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The entire treatment of claims 30 and 31 in the Office Action is as follows:
"Claims 30-31 are met by that discussed above for claims 1, 8, and 29. The information represented by the histogram of Figure 6A is generated for determining the necessary bandwidth." Office Action at page 8. However, this ignores several limitations that are found only in claim 30.

For example, unlike the claimed invention, Lakshman does not generate a histogram of bitrate as a function of time for an entire multimedia program before transmission thereof to a multimedia node. As noted above, Lakshman relates to video that has not yet been encoded, such as in a video conference. Col. 9, lines 64-67. Hence, Lakshman cannot generate a histogram for an *entire* multimedia program before it is transmitted to the multimedia node. As noted above, the "histogram" of FIG. 6A is not a histogram of a particular program to be transmitted to a multimedia node. Rather, it is a "studied sequence" used to develop a mathematical model for predicting demand during transmission of a particular "type" of multimedia data.

Lakshman also does not perform the step of "identifying, during transmission of the multimedia program, an actual bitrate spike within the bitrate histogram for the multimedia program, the actual bitrate spike temporarily requiring more than the available network bandwidth for transmission of the multimedia program." Lakshman's "histogram" does not allow a server to identify an upcoming bitrate spike during transmission of an associated media program. His "histogram" merely says, for example, that there were a total of 1000 occurrences of frames that include 100 cells, and is not even specific a particular media program to be transmitted, as previously explained.

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Moreover, Lakshman does not temporarily increase a program's bandwidth allocation in anticipation of the actual bitrate spike indicated in a bitrate histogram to fill a buffer at the multimedia node to avoid a buffer underrun during the future bitrate spike. At best, Lakshman only predicts (501) the need for rate allocation for future frames and provides (502) the predicated rate to a network. The network allocates (504) bandwidth in response to the request and advises (504) the source of an explicit rate based on the actual available bandwidth. The encoder at the source then adjusts (505) the current rate based on the advised explicit rate. The fact that Lakshman's encoder adjusts the encoding rate clearly shows that the media program has not yet been encoded, contrary to the claimed invention.

Also, adjusting the encoder means reducing quality where insufficient bandwidth exists to transmit the media program. This is completely different from the claimed process of temporarily manipulating the bandwidth allocation based on foreknowledge of upcoming bitrate spikes so that the media program is transmitted with perfect quality. In such cases, Lakshman always results in quality loss, whereas the claimed invention preserves quality.

In view of the foregoing, the applicant respectfully submits that claims 1-31, as amended, are patentably distinct over the cited references, alone or in combination. A Notice of Allowance is respectfully requested. If any issues remain after this response, the Examiner is invited to contact the undersigned at the telephone number provided below.

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